



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# COVID-19 energy sector responses in Africa: A review of preliminary government interventions

Mark McCarthy Akrofi<sup>a,\*</sup>, Sarpomg Hammond Antwi<sup>b</sup>

<sup>a</sup> Institute of Water and Energy Sciences, Pan African University, Tlemcen 13000, Algeria

<sup>b</sup> Dundalk Institute of Technology, Centre for Freshwater and Environmental Studies, Dundalk, Co.Louth A91 K584, Ireland

## ARTICLE INFO

### Keywords:

COVID-19  
Energy  
Coronavirus  
Energy transition  
Africa  
Energy policy

## ABSTRACT

The COVID-19 pandemic has unleashed unprecedented shocks across all facets of society, from strained healthcare systems to the closure of schools and economies. The energy sector is of no exception, with several concerns being raised about the ramifications that will arise for the clean energy transition. The goal of our study is to review how governments in Africa have responded to this challenge in the energy sector. We used an internet search to gather information from government policy statements/briefs, and websites of international organizations such as the IMF, WHO, KPMG, and the World Bank. Our review revealed that the majority of preliminary responses were short-term and include the provision of free electricity, waiver/suspension of bill payments, and VAT exemptions on electricity bills. These measures were more pronounced in sub-Saharan Africa while oil-rich countries of the North mostly have broad economic measures that target their oil and gas sectors. Economic stimulus packages prepared by most countries do not explicitly mention energy sector companies/institutions, especially the Renewable Energies (RE) sector. Only three countries (Nigeria, Kenya, and Burkina Faso) had specific interventions for renewables. Overall, interventions were mostly fiscal/financial and short-term, with medium to long term measures often broad without being specific to the energy sector. As governments take measures to bolster their economies, they must pay particular attention to the challenges posed by the pandemic in the energy sector and capitalize on the opportunities that it presents to drive the clean energy transition.

## 1. Introduction

The COVID-19 pandemic has unleashed unprecedented shocks across all facets of society, from strained healthcare systems to the closure of schools and economies. The energy sector is of no exception with several connoisseurs already raising concerns about the ramifications that will arise for the clean energy transition and the fight against climate change [1,2]. With travel and transport restricted across several countries in the world, global oil demand has dropped to its lowest since 1995, and lockdown measures have drastically reduced electricity demand. According to the International Energy Agency (IEA), global electricity demand decreased by 2.5% in the first quarter of 2020 with full lockdown measures causing a daily reduction of at least 15% in Italy, Spain, the United Kingdom, France, India, and the United States [3]. Construction of new energy facilities has either been delayed or stopped, and the Renewable Energy (RE) sector is worst affected. China, the leading global producer and supplier of clean energy technologies has been severely hit by the pandemic, hence, disrupting the delivery of

RE technologies such as solar panels, wind turbines, and batteries. An estimated 3000 MW of solar and wind energy projects in India face delays due to coronavirus lockdown. Also, the Chinese company, BYD which is one of the world's leading producers of rechargeable batteries was unable to complete tests of new battery models due to the COVID-19 pandemic [4]. The pandemic, therefore, threatens the achievement of universal energy access, particularly in the developing world such as Africa.

According to the Global Off-Grid Lighting Association (GOGLA), the COVID-19 pandemic threatens to reverse the enormous progress that off-grid energy companies have made to bring power to some 470 million people in the last decade [5]. This situation holds very troubling implications for the African continent because a stall in progress towards universal energy access will potentially worsen poverty and inequalities. According to the International Renewable Energy Agency (IRENA), off-grid applications provide electricity to some 60 million people on the continent [6]. In addition to electrification, off-grid renewable energy development is also addressing the unemployment

\* Corresponding author.

E-mail address: [macakrofi@gmail.com](mailto:macakrofi@gmail.com) (M.M. Akrofi).

<https://doi.org/10.1016/j.erss.2020.101681>

Received 5 June 2020; Received in revised form 23 June 2020; Accepted 24 June 2020

Available online 06 July 2020

2214-6296/ © 2020 Elsevier Ltd. All rights reserved.

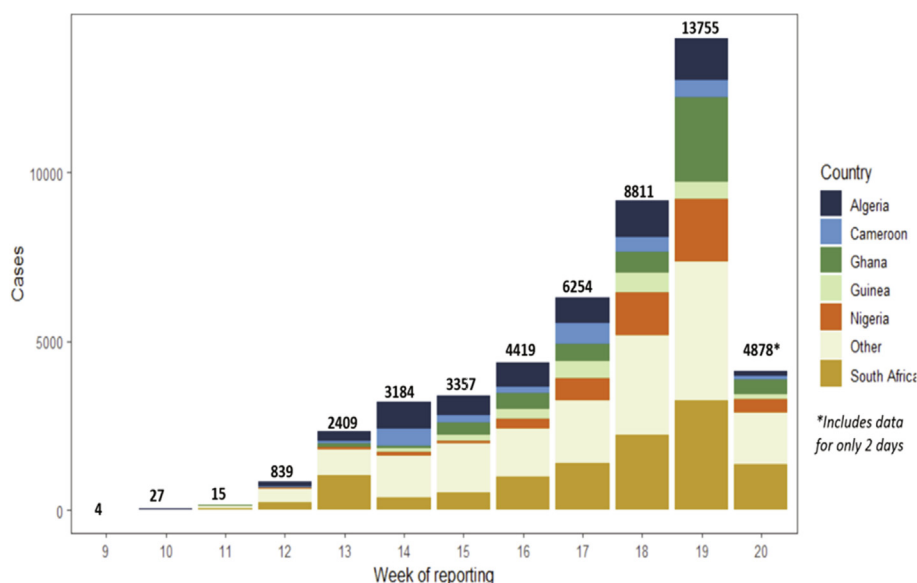


Fig. 1. Weekly number of confirmed COVID-19 cases in the WHO African Region by country, February 25–May 12, 2020 (n = 47 953). .  
Source: [24]

problem in Africa. The IRENA estimates that solar PV jobs employ some 3.9% [7] of the African workforce with the decentralized RE value chain employing about 77,000 people in East Africa, 26,000 in West Africa, and 7,000 in central Africa [8]. COVID-19 threatens to undo all this progress because with declining liquidity, off-grid and decentralized RE companies will be forced to cut jobs or even lay-off staff, hence, putting jobs in this sector at risk.

Governments around the world are taking measures to support the energy sector and to mitigate the adverse effects of the pandemic. These measures vary across countries and their implication is something that will be understood over time. The whole range of consequences of the COVID-19 for the energy sector is still evolving and is difficult to predict. In some countries such as Ghana, the government has decided to absorb the cost of electricity during the lockdown periods while in many other countries, customers have been advised to delay the payment of their utility bills. Some countries have also waived interest rates and placed bans on disconnections, restricted regular maintenance activities, and postponed or suspended planned power interruptions to ensure reliable power supply during the pandemic [4]. While these abrupt but necessary measures have provided some relief in the short term, the real consequences of these government interventions are yet to be revealed. In general, the effects of the pandemic for energy systems and the clean energy transitions are still evolving, and there is the need for careful policy considerations to ensure that policy actions taken now do not create adverse effects especially for sustainable energy transitions in the long term. It is, therefore, paramount to document and track various interventions that governments are taking now in order to examine and better understand the future implications that they present.

Thus far, very few studies exist on COVID-19 and energy policy issues. Qarnain, Muthuvel, and Bathrinath [9] reviewed government action plans of G-20 countries to minimize energy consumptions in buildings during the pandemic. However, the government actions identified in their review rather portray measures to ensure a sustained supply of electricity to end-users rather than to encourage them to reduce their energy consumption. In fact, some of the actions taken by governments such as providing discounts on electricity bills, deferment of bill payments, suspension of service interruptions, and suspension of bill payments [9] rather seem to encourage more energy consumption than to reduce it. Klemeš, Fan, Tan, and Jiang [10] also examined plastic waste, energy and environmental footprints related to COVID-

19. Their review found that energy and environmental footprints of plastic products have increased rapidly as the number of COVID-19 cases increased globally. Steffen, Egli, Pahle, and Schmidt [11] identified short term, medium-term and long term energy policy challenges of COVID-19 for policymakers. They recommended that policymakers must: not overact in response to COVID-19 in the short term, take advantage of new opportunities for the energy transition in the medium term, and formulate policies that can withstand future shocks [11]. There is a relatively higher number of studies focusing on COVID-19 and the environment as compared to COVID-19 and energy. A stream of studies deals with the impact of COVID-19 on the environment in general [12–14]. Others have focused on the relationship between COVID-19 and specific aspects of the environment such as air quality and environmental pollution [15,16], temperature and weather [17–21] and environmental strategy [22].

Energy and environmental issues are intrinsically linked. Hence, energy sector strategies adopted during the pandemic will have implications for the environment especially, the fight against climate change. Research is, therefore, needed to understand these connections. The goal of our study is to review energy sector government interventions in response to COVID-19 in Africa. We attempt to answer the questions: 1) What forms of COVID-19 energy sector responses have been taken in Africa? 2) What is the nature of these interventions? 3) What is the future outlook for energy policy and research? We present an overview of the COVID-19 situation in Africa in the ensuing section. In section 3, we present the results of our review, and in Section 4, we present conclusions, recommendations and future research outlook.

## 2. Overview of the COVID-19 pandemic in Africa

The first COVID-19 case in Africa was reported on February 14, 2020, in Egypt. In the same month, Algeria and Nigeria also recorded their first cases, with Nigeria being the first country in sub-Saharan Africa to report a case. By March 3, 2020, there were a total of 11 cases in the entire continent with Senegal reporting its first case 2 cases in the previous day. All cases during this period were imported with no known community transmission except for Algeria where five locals contracted the virus through contact with two foreign nationals who tested positive for the virus in the country [23]. No deaths were reported during this period. As of the time of writing, the number of cases has grown from 11 on March 3, 2020 to 47,953 with 1488 deaths by May 12, 2020

[24]. A total of 47 countries have reported cases at this date with nine countries: South Africa (11,350), Algeria (6067), Ghana (5127), Nigeria (4787), Cameroon (2689), Guinea (2298), Senegal (1995) Côte d'Ivoire (1857) and the Democratic Republic of the Congo (1169) registering a cumulative total of more than 1000 confirmed COVID-19 cases [24]. Fig. 1 shows the weekly accumulation of cases between February 25 and May 12, 2020.

The case fatality rate (CFR) stood at 3.1% and the highest case load was observed in West Africa 43% (20 611, CFR 2.1%), followed by the Southern region 24% (11 575, CFR 1.8%), the North 8.5% (6 067, CFR 8.5%), Central 13% (6 377, CFR 3.9%) and Eastern regions 7% (3,323, CFR 2.6%)[24]. Of the total number of cases, 35% were reported to have recovered from 45 countries [24]. In order to stem the spread of the virus, several countries began putting in place measures such as the closure of borders, travel restrictions, ban on international travels (both departure and arrivals), physical distancing, and contact tracing. As the number of cases continued to rise, governments started introducing lockdowns in order to contain and stop the spread. Rwanda was the first country in the WHO Africa region to implement a lockdown on March 21, 2020. Since then, 21 more countries have implemented total (11) and partial (10) lockdowns as of April 2020 [25]. However, unlike most of the developed countries, implementing lockdowns in Africa was very challenging. Huge proportions of the population are engaged in informal sector activities for their livelihoods, water and electricity infrastructure are inadequate, and the risks of economic recession were much higher. This situation has raised a series of queries as to whether lockdowns were the right measures to implement in the continent [26]. To minimize the negative impacts of the lockdowns, governments have introduced several social interventions across the continent. Countries such as Madagascar, Uganda, and Rwanda distributed free food to the poor and vulnerable while others such as Ghana offered free water for the lockdown period. Similar measures were adopted in several other countries. Gentilini, Almenfi, Orton, and Dale [27] present a synthesis of these social protection interventions to COVID-19. However, with inadequate funds to sustain these interventions, a comprehensive and prolonged lockdown was not practical. Consequently, many countries as of May 2020 have started to ease their lockdown restrictions.

With the easing of lockdowns, comes the question of how to get the economy back on track in order to avoid dangerous recession. In response, governments have instituted several measures in the form of aid packages and regulations to safeguard their economies. Energy is the engine of economic growth as it plays a crucial role in production processes, transport/mobility, and job creation. With the disruption caused by COVID-19, it is imperative to understand how the pandemic has affected the energy sector and what implications it holds for the future. We contribute to this understanding by synthesizing the various responses that various African governments have put in place with specific reference to the energy sector. Given that the COVID-19 situation is still evolving, our study aims to provide a baseline for which future studies can build upon. In the following section, we present various interventions implemented using themes based on the five regional divisions in Africa.

### 3. Energy-related COVID-19 interventions in Africa

Africa has enormous energy potential, both renewable and non-renewable. The distribution of these resources, however, varies between countries and there are variations in their energy sectors as well. The COVID-19 situation and its impacts also vary across countries; hence, interventions are not the same for all of them. No comprehensive studies on these impacts exist at this time. However, commentaries on the issue reveal some initial impacts on Africa's energy sector. These impacts range from declining exports of energy resources to disruptions in the construction of new energy projects. China depends largely on Africa for iron ore, lithium, copper, and cobalt. However, Stevens [28] recounts that COVID-19-induced shutdowns have reduced demand for

these minerals, and African companies that produce them are currently witnessing a decline in demand from China. Oil and gas producing countries are also suffering from the global decline in demand, and fall in oil prices [29]. Port closures and production shutdowns, for instance, have caused Chinese importers to cancel their oil purchases from Africa [28]. COVID-19 has also affected the off-grid energy sector in Africa. Havenhill Synergy, a clean-tech utility company in Nigeria, for instance, reports that due to port closures and movement restrictions, off-grid energy developers are facing significant challenges in obtaining equipment and accessing project sites in the country [30]. This situation has reportedly delayed the timelines of various RE projects. According to the IEA, a recent survey conducted by the Global Off-Grid Lighting Association shows that half of off-grid energy companies face substantial financial challenges [29]. About 67% of mini-grid operators and 75% of solar home system suppliers have funds to cover only two months of their operating expenses [29].

On the demand side, confinement measures have resulted in an increase in residential electricity demand [30]. According to the IEA, the imposition of lockdowns has resulted in a cut in disposable incomes [29]. This situation has raised questions as to whether households will be able to pay for their electricity bills [29,30]. An ongoing study by GOGLA on consumer insights with regard to off-grid energy applications in the time of COVID-19 shows that the utilization of such applications has slightly increased as a result of the pandemic. The survey which is still ongoing and includes eight African countries, shows that 16% of users reported a 'very much more than normal' increase in their usage of off-grid applications while 18% reported a 'slightly more than normal' usage [31]. However, the majority of users (51%) reported no changes at all while only 4% of them reported a 'much less than normal' usage. Like many other parts of the world, the COVID-19 has impacted heavily on the transport sector (one of the major energy-consuming sectors) especially, the aviation industry in Africa. There has been a severe decline in aviation demand resulting from the suspension of commercial passenger flights and the closure of airports. Fewer people are also willing to travel now due to fear of the COVID-19 [32]. While declines in air travel provide environmental benefits such as reduced CO<sub>2</sub> emissions, the economic downturn on African economies is enormous. The International Air Travel Association (IATA) [33] estimates that air traffic in the region will decrease by 51% in 2020. Consequently, airlines could lose about USD 6 billion in passenger revenues with a potential 3.1 million job losses in aviation and its related industries [33]. Hardest hit countries include Ethiopia, Nigeria, South Africa, Ghana, Tanzania, Kenya, Mauritius, Mozambique, Senegal, and Cape Verde [33].

With fragile energy infrastructure and a high level of energy poverty in Africa, governments must pay particular attention to the implications of the pandemic for the energy sector, especially for advancing energy access and the clean energy transition. Government decisions in the energy sector significantly influence poverty reduction [34], but they may be influenced by political priorities [35]. What interventions and for whom they are targeted could also raise issues of social justice, fairness, and exclusion in the energy sector [36,37]. In this section, measures that have been instituted in various countries in response to the pandemic are discussed. Overall, we found specific energy-related interventions in 23 countries. Fig. 2 presents a summary of specific COVID-19 energy sector interventions in these countries.

In the ensuing sections we discuss the results in details for each of the five regions in Africa—North Africa, Southern Africa, West Africa, East Africa, and Central Africa.

#### 3.1. North Africa

The decline in global oil prices has been a blow to many North African countries where the wheels of economies run heavily on oil, a phenomenon that is shaping responses of countries to COVID 19 in the region [38]. In Algeria, the government has reiterated her commitment

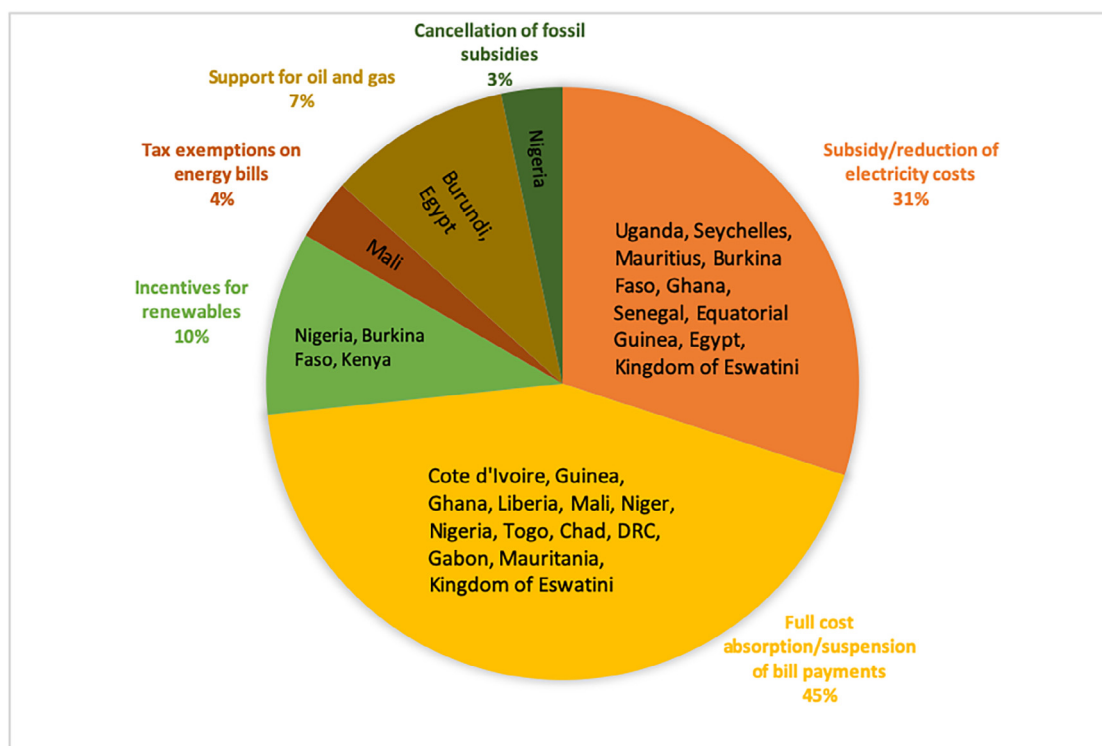


Fig. 2. Immediate energy-sector COVID-19 responses in Africa (Authors' construct, created with Microsoft Excel).

to maintaining wages and social spending, despite a 30% cut in public spending, necessitated by the global fall in oil prices and forecast indicating a decline in Algeria foreign reserves from \$62 billion to \$51 billion by the end of the year. The aviation sector which also contributes to the Algerian economy is currently under stress with the risk of over 169,800 job losses and \$0.8 billion revenue losses [39]. Despite declining reserves and public spending amidst COVID-19 pandemic, oil giant, Total was denied from acquiring oil and gas assets in the country [40,41]. Whereas in neighboring Morocco, there is a decree-law adopted by the government to increase external borrowing beyond what was approved under the 2020 budget as a result of COVID-19. There is also a precautionary and Liquidity Line (LPL) fiscal intervention worth 3 billion dollars repayable in 5 years in agreement with the IMF [42]. Although many sectors of the Moroccan economy stand at risk, the Department of Energy considers import, storage, and transport of hydrocarbons as well as renewable energy-related works as not negatively affected by the COVID-19 pandemic, hence unfit for government support aimed at supporting the sector [43]. Nonetheless, there is a monitoring unit tasked to supervise the energy supply process during the pandemic period as gas stations struggle with revenues which have been falling at about 80% [44]. The Moroccan aviation sector is also facing losses in turnover amount of over \$5.2 million dollar per day, which may take not less than 36 months to balance the incurring deficits [45]. On the contrary, sectors such as extraction, telecommunication, and agri-businesses according to the Moroccan Professional Federation have not had any significant impact on productions and services since the COVID-19 pandemic began [46].

In in Egypt, the cost of natural gas and electricity for industrial usage has been reduced from \$5.50 per million British thermal units (Btu) to USD 4.50 in Egypt. Electricity cost for heavy industries has also been reduced from 1.10 to 0.10 Egyptian pounds, with these prices expected to cushion the economy for at least five years [47]. These reductions have made natural gas more competitive to alternative energy sources like solar and wind. This may further fraught efforts on subsidy on renewables especially as industries look to mitigate the economic impact of COVID 19 [48]. A stimulus package of \$6.13 billion

has been announced by the government to mitigate the impact of COVID on the Egyptian economy, which has tourism and remittances as key contributors [38]. Tunisia has no direct stimulus package for the utility sector but has put in place a COVID-19 emergency plan that includes a \$0.71 billion financial pack to absorb the impact COVID-19 will have on the economy coupled with the postponement of CIT payments, VAT exemptions and liquidity for the private sector to guide against lay-offs especially in the informal sector [38].

In Mauritania, the government has announced an \$80 million fund to cater for medical supplies and subsidies for the poor, including the exemption of 174,707 households from electricity bill for two months. These measures have been put in place to support vulnerable people in the country [49]. However, in war-torn oil-rich Libya, the Libyan Government of National Accord (GNA) has announced a 20% pay cut for civil servants, and a 500 million Libyan Dinnar package as COVID-19 emergency package after the National Center for Disease Control, reported 64 cases of COVID-19 and three associated deaths [38]. How this fund is to be spent is not yet clear. The United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) has, however, raised concerns about funding to support vulnerable communities in Libya. The UNOCHA requires over \$115million to assist over 345,000 vulnerable homes without access to water and electricity, especially in this period of the pandemic [50].

There is presently no information on any intervention in Western Saharan. Sudan and South Sudan also have not had any direct stimulus packages in place to mitigate the impact of COVID 19 on the economy or the energy sector. However, licenses for oil blocks in South Sudan have been deferred indefinitely due to the COVID- 19 pandemic which has left oil companies like China National Petroleum Corporation (CNPC), India's Oil and Natural Gas Corporation (ONGC) and PETRONAS of Malaysia uncertain about production trends post-COVID-19 [51,52]. In Sudan, preparation to freeze loan repayments and services for three months to ease pressure on the private sector has only been proposed but not in effect. South Sudan has put in place precautionary measures such as international flight suspension, evening curfews and mandatory quarantine in full force but no key fiscal and monetary

intervention in any sector of the economy [38]. Except for Egypt where the financial stimulus for the economy is aimed at a long-term cushioning of the country for three to five years, most of the stimulus packages by other North African countries are short-term and aimed at subsidies on wages and medical expenditure. Specific energy interventions found include the provision of free electricity by the government (Mauritania) and reduction of electricity prices (Egypt).

### 3.2. Southern Africa

Countries in southern Africa are rolling out various measures to tackle the impact of COVID-19; however, plummeting oil and natural resource prices are affecting measures introduced by some countries in the region. The majority of countries have not implemented any major energy reforms despite a general decline in system load for some countries that have gone into lockdown [53]. In Angola, the 2020 National budget was planned on an oil price of \$55 per barrel, but plummeting oil prices means substantial cuts to budgetary allocations which have resulted in limited revenue, spending cuts and inadequate investments in the energy sectors [54]. Planned drilling of some oil fields has also been deferred to at least 2021 due coronavirus pandemic [55]. However, the Angolan government has announced a 40million dollar healthcare package, a tax exemption on humanitarian aid and delay in tax files to ameliorate, the impact of COVID-19 on the economy which has not recovered from the 2014–2016 oil crash [56]. Angola's rank on World Bank 2020 doing Business Index has moved down to 177 out of 190, same as in Botswana where diamond sales and slow tourism activities are having a toll on the economy. But under an Emergency Power Act (Cap.22.04), the government has released a 2 billion pula to cater for wage subsidies and a financial waiver on training levy for six months with companies engaged in Water and electricity supply, the health sector and other parastatal companies [57,58]. On the contrary, amidst the COVID-19 crises, the Botswana Power Corporation on April 1, 2020, increased electricity tariffs by 22% in a bid to increase revenues for the loss-making power corporation [59]. An inter-ministerial committee coordinating responses to COVID-19 has also been in place in Lesotho even without any COVID-19 recorded case as of May 7, 2020. The Monetary policy committee and the Central Bank of Lesotho as part of preparedness and responsive plan have set to reduce policy rate from 6.25 to 4.25%, campaigns for the adaptation of non-cash payments are in place with mobile network operators asked to removed fees on transactions below M50 [38].

Falling gas prices are threatening the gas-driven economy of Mozambique. The northern part of the country became the Covid-19 outbreak centre where oil giant, Total S.A, has liquefied natural gas assets of over \$20 billion [60]. Although, there are no immediate measures aimed at bolstering the energy sector against the COVID 19 impacts, budgetary allocation for health care services in Mozambique has also been increased from MT 2 billion to MT 3.3 billion with the government pleading with development partners for an additional 700 million to help deal with the economic impact of COVID-19. While the Mozambique government is counting on foreign aid to boost the economy, Namibia has in place an 8 billion Namibian dollar economic stimulus and relief package to mitigate the impact of COVID-19 to support Agric-business and subsidy for wages and health needs. Beyond these, there are no significant plans and interventions by the Namibian government [61]. Among measures taken by the Kingdom of Eswatini includes a reduction of discount rate twice by a cumulative 200 basis points to 4.5%, a reduction of liquidity requirement by 20%, and restructuring of loan repayments. Fuel prices have also been reduced since April 2020 with the suspension of prices of electricity for an additional two months [62].

South Africa, which by far has the highest number of confirmed cases, has also instituted some economic measures to bolster the economy. Economic interventions include unemployment insurance fund of 30 billion rand for workers who have lost their jobs. There are

also tax subsidies for small businesses. The South African Reserve Bank has decreased the interest rate by 100 basis points. Eskom estimation also reveals that Electricity demand during COVID-19 lockdown has increased by 7500 MW, which corresponds to about a quarter of its standard peak capacity [42,63]. Consequently, Eskom (South Africa's public utility) has decided curtail supply from wind farmers and other energy producers through a force majeure. Such action will impact renewable energy targets; which may trigger load shedding in the foreseeable future, should most energy producers fold up [53]. Nevertheless, there has not been any intervention in the energy sector despite the increasing demands in recent times. The decline in copper prices has also proven economically difficult for the Zambian government in drawing up a comprehensive fiscal or monetary plan to support the economy amidst COVID crises.

In the same vein, the government of Zimbabwe has also declared a national disaster with a 2.2 billion domestic and international humanitarian appeal from April 2020 to April 2021. An economic recovery and stimulus package which includes measures to provide liquidity support to several sectors, including SMEs (about ZWL\$0.5 billion) has however been announced by government [38]. A \$220 million fund announced by the government will aim at fighting COVID-19, US \$37 million for another critical health spending, and US\$34 million for water, sanitation, and hygiene (WASH). Other critical needs include US \$956 million for food insecurity and US\$20.8 million for social protection. The Zimbabwe Electricity Transmission and Distribution Company (ZETDC) and Zimbabwe Energy Regulatory Authority (ZERA) have, however, agreed to an electricity increment from 38.61cent to 162.16cents. The price increment is to enable ZETDC to raise funds to repair generators and to pay for electricity importation from South Africa and Mozambique [38,64]. While electricity prices are being increased, the system load of Zimbabwe had reduced by 25% since the country went into lockdown on March 30, 2020. Only the Kingdom of Eswatini reduced electricity prices and suspended the payment of electricity bills for two months. The reverse is the case in Zimbabwe where prices were rather increased.

### 3.3. West Africa

Except for Benin and Guinea-Bissau, all west African countries have enacted some of form energy-related measures in response to the COVID-19 as of the time of writing this paper. Following the implementation of total and partial lockdowns, governments sought to ease the resultant burden that fell on their citizens, especially poor and marginalized groups. These measures came in the form of electricity bill waivers, suspension of bill payments as well as fiscal and regulatory measures. In Burkina Faso, the government introduced a 50% reduction in electricity bills and canceled penalties on invoices by the country's major utility companies [65]. The government of Cote d'Ivoire postponed deadlines for the payment of electricity and water bills and suspended the payment of such bills for underprivileged groups for three months [66]. In Ghana, the cost of electricity for lifeline electricity consumers (persons who consume zero to fifty-kilowatt hours a month) was fully absorbed by the government with a 50% absorption of the bills of all other consumers [67]. Similar measures were found in six other countries. Fig. 3 summarizes these interventions.

Most of the measures in Fig. 3 were short term, often spanning two to three or four months. Notably, only Nigeria and Burkina Faso had some explicit interventions/incentives for renewable energies. In Nigeria, four renewable energy companies were selected to receive a share of the \$500,000 relief fund from the Nigerian off-grid energy investing company known as "All-On," which was established by Shell [68]. Nigeria is also ending fossil fuel subsidies, particularly for the gasoline sector in the country [69]. This move was triggered by the global fall in oil prices due to the COVID-19. In Burkina Faso, the government introduced a 50% reduction in the cost of solar kits for vulnerable households [65]. All countries, with the exception of Benin

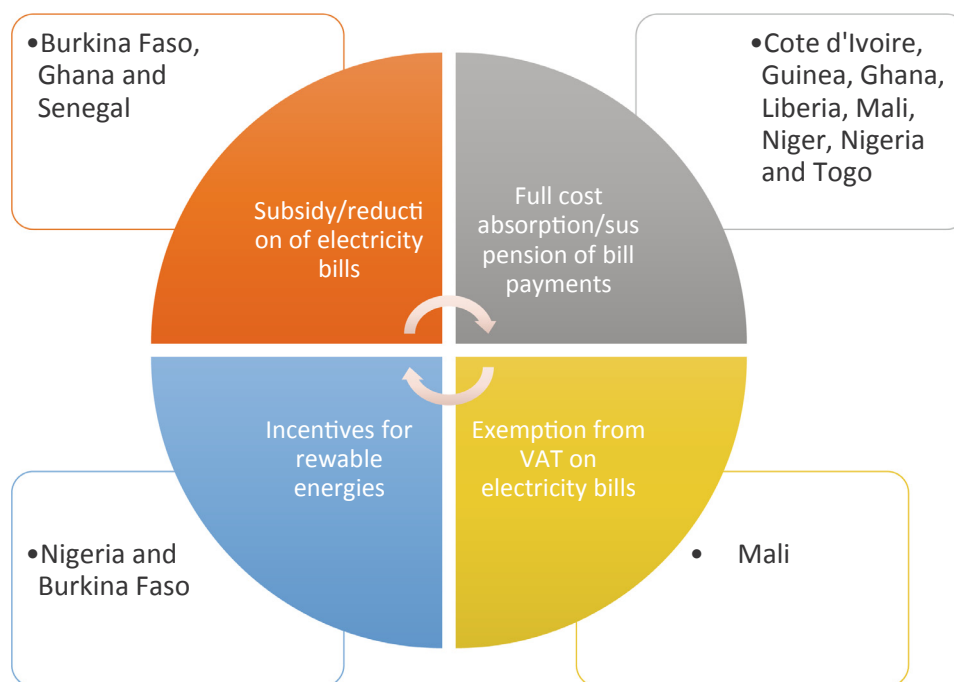


Fig. 3. Summary of immediate energy sector responses to COVID-19 in West Africa (Authors' construct, created with Microsoft Word).

and Guinea-Bissau, have also put in place some broad fiscal measures to protect small and medium enterprises as well as companies. However, these measures do not explicitly mention energy start-ups, utilities, or companies. The government of Cabo Verde, for instance, has introduced loan guarantees of up to 50% for large companies in all sectors (with an amount of about 9 million euros), 100% for small and medium-sized enterprises (SMEs) in all sectors (about 2.7 million euros) and for micro-enterprises in all sectors (about 6.7 million euros) [38].

Similarly, the government of Cote d'Ivoire has dedicated about 0.4% and 0.3% of its GDP to a support fund for small and medium enterprises, and large companies, respectively. An economic stimulus package has also been put in place to ease liquidity constraints on ailing firms, including all SMEs in Mali. The package also includes granting tax deferral and relief to ease liquidity constraints on the hardest-hit companies [38]. In Sierra Leone and Senegal, broad fiscal measures have been introduced to safeguard the economy. Nigeria has also drafted an Emergency Economic Stimulus Bill which is yet to be voted into law [68]. Notably, the coverage of these interventions is broad, often targeting SMEs and larger companies in general. Off-grid and decentralized electricity companies, as well as other energy firms could be included in these interventions, but they are not explicitly mentioned. Most countries seem to emphasize on the hospitality sector. In addition to these financial measures, some countries as of the time of writing, have also prepared legal bills that are pending parliamentary approval in response to the COVID-19. In all, the majority of interventions in West Africa thus far are short term, with most of them seeking to ease the immediate burden that lockdowns have brought in the various countries. However, due to the evolving nature of the virus, governments are keenly monitoring the situation and they are progressively initiating medium and long-term measures in response to the anticipated impacts on the economy.

### 3.4. East Africa

The East African region as a whole had a relatively fewer number of interventions for the energy sector as compared to other regions in the continent. Only Mauritius, Uganda, Kenya and Seychelles had some explicit incentives for the energy sector. In Mauritius, the government introduced a 20% reduction in the electricity bills for some 65,000

vulnerable households and a 10% reduction for small businesses whose electricity consumption does not exceed 125 kW [42]. A stimulus package in Uganda purports to support water and electricity utilities during the pandemic, but the specifics of this support were not given. In Burundi, the government has earmarked about USD 6.3 million (0.2 percent of GDP) to bolster its strategic oil reserves [38]. The Seychelles government also plans to maintain electricity tariffs at the same level for the public sector in order to allow the Public Utility Company to pass this extra benefit to other sectors. People in the domestic sector will also have 25 cents per unit, with a reduction in electricity tariffs. In comparison, the commercial sector will benefit from a reduction of more than 25 cents per unit on their electricity tariffs [70]. The Swedish government, through the African Enterprise Challenge Fund (AECF) has launched the REACT Kenya Relief Fund, a USD 2 million fund intended to assist energy companies that are facing challenges as a result of the COVID-19 in Kenya [71]. The fund aims to support energy companies that are providing electricity to off-grid communities in rural and peri-urban areas. Its objective is to make energy access an essential service during the COVID-19 pandemic. It also aims to provide relief to off-grid energy companies in order to prevent adverse effects of the pandemic on their employees, customers, and supply chains [71].

Except for these four countries, all other countries had very broad fiscal and economic stimulus packages that do not specifically focus on energy. In Rwanda, for instance, the government is preparing to launch a support fund for affected businesses through subsidized loans from commercial banks and credit guarantees while in Tanzania, the government has accelerated the payment of verified expenditure arrears giving priority to affected SMEs amounting to about USD 376 million [38]. No direct interventions for the energy sector were found in Somalia; however, the central bank is releasing funding to support medium and small enterprises through commercial banks with an initial amount of USD 2.9 million. In Malawi, an emergency cash transfer program of about USD 50 million (0.6 percent of GDP) is planned to be implemented between May and November 2020 to support small businesses in major urban areas. For the same purpose of supporting SMEs, commercial banks and micro-finance institutions will, on a case-by-case basis, restructure SME loans and provide a three-month moratorium on their debt service [38]. On May 4, 2020, authorities in Zimbabwe announced a COVID-19 economic recovery and stimulus

package which includes measures to provide liquidity support to several sectors, including SMEs (about ZWL 0.5 billion) [38].

In Kenya, no specific measures such as waiver of utility bills or suspension of bill payments were found for the energy sector, even though the government has allotted some Ksh40 billion for health and social protection alongside some tax exemptions [38]. In addition to the stimulus package for water and electricity, the Ugandan government has also indicated that with effect from March 31, 2020, it will allow Ugandan businesses facing economic distress to reschedule their National Social Security Fund (NSSF) contributions for three months without accumulating a penalty [66]. On April 3, the Ethiopian Prime Minister's office announced a COVID-19 Multi-Sectoral Preparedness and Response Plan, with prospective costing of interventions and support for SMEs. The government also introduced a tax amnesty on interest and penalties for tax debt pertaining to 2015/2016–2018/2019, and exemption from personal income tax withholding for four months [38]. Similar tax reliefs were present in Madagascar while countries like Mozambique, South Sudan, Eritrea, and Djibouti amongst a few others had no specific interventions for the energy sector nor economic stimulus packages as of the time of writing.

Overall, very few countries in the East African region had specific interventions for the energy sector. These specific interventions were: subsidizing/reduction of electricity bills (Uganda, Seychelles, and Mauritius), relief funds for renewable energy companies (Kenya), and Support package for the oil industry (Burundi). These interventions were mostly short-term. The majority of the countries had broad economic stimulus packages that are not specific to energy. With the exception of Kenya, no specific interventions were found for the renewable energy sector.

### 3.5. Central Africa

With only eight countries, the central Africa region has the fewest number of countries among the five regions on the continent. Initial energy-sector responses in this region were consistent with those found in other sub-Saharan African countries. They were mostly fiscal/financial and short-term with long term measures often broad without being specific to the energy sector. Reductions and waiver/suspension of electricity bills were found in countries such as Equatorial Guinea, Chad, Democratic Republic of Congo (DRC), and Gabon. These measures were on a temporary basis, often spanning from two to three months. In Equatorial Guinea, electricity bills were reduced for households and firms affected by the pandemic, especially SMEs [38]. A similar measure was adopted in Chad, where the government decided to pay the electricity bills of vulnerable households for a three-month period. Like Chad, the government of Gabon provided free electricity to its most vulnerable and economically disadvantaged people, while in DRC, free electricity was provided to all households for two months [27]. Countries like Cameroon, Central African Republic (CAR), Republic of Congo, and São Tomé and Príncipe did not have any specific interventions related to energy. Broad financial/economic measures such as tax holidays and VAT exemptions were, however, put in place.

In the Congo Republic, for instance, corporate income tax was reduced from 30% to 28% and the turnover tax has been reduced from 7% to 5% for small businesses with turnover below 100 million XAF [38]. Measures including a decrease of the policy rate by 25 bps to 3.25 percent, a decrease of the Marginal Lending Facility rate by 100 bps to 5 percent, a suspension of absorption operations, and an increase of liquidity provision from FCFA 240 to 500 billion were also announced in CAR. The government of São Tomé and Príncipe also encouraged its commercial banks to reduce some banking fees and grant a temporary moratorium on debt services to businesses affected by the crisis, while the Cameroonian government has amongst others, allocated a special envelope of CFAF 25 billion for the expedited clearance of VAT credits awaiting reimbursement [38]. In addition to the electricity bill waivers and suspensions in the rest of the countries, similar economic measures

were also put in place.

The Chadian government, for example, plans to reduce business license fees by 50% in order to support SMEs while in DRC, VAT collection on the production and sales of basic goods and tax audits for companies has been suspended. A grace period for businesses on tax arrears was also introduced [38]. In Gabon, an additional mechanism of around USD 375 million has further been announced to facilitate access to commercial banks financing for private (formal and informal) companies, including SMEs [38]. All these measures are very broad and often target SMEs. Consistent with the findings in other regions of Africa, energy-related responses in the central African region are also characterized by short-term interventions while medium to long-term measures were often broad and fiscal/financial in nature. Specific measures adopted for the energy sector include subsidization/reduction of electricity bills (Equatorial Guinea) and absorption of the full cost of electricity bills by the government (DRC, Chad, and Gabon).

## 4. Conclusions and recommendations for future research

The COVID-19 situation is still evolving and so are its impacts across several facets of society. With regard to energy, one thing that is clear so far is that the pandemic has significantly reduced energy demand globally. Residential energy demand has, however, increased in some countries as a result of lockdown measures. Following restrictions imposed in response to the outbreak, several African countries have implemented several measures to support their citizens and their economies. Our review focused on identifying measures that were adopted for the energy sector. Overall, we find that immediate measures adopted included the provision of free electricity, waiver/reduction of electricity bills, VAT exemptions on electricity bills, some cost reductions on solar lamps, and relief funds for renewable energy companies. Only Burkina Faso had cost reductions for solar lamps while Nigeria and Kenya had relief funds for renewable energies. These measures were also short-term, often spanning two to three or four months. All the interventions above were also more profound in sub-Saharan Africa, while oil-rich countries of the North have focused on measures to safeguard their oil and gas sectors. Algeria, for instance, prevented oil Giant Total from taking advantage of the pandemic to acquire some oil and gas assets in the country.

Apart from the measures above, the majority of responses found in all countries were very broad in the form of aid packages, economic stimulus packages/bills, and monetary/fiscal incentives to boost liquidity in their economies. These measures often targeted large companies and SMEs. While sectoral details of these interventions were often not given, the hospitality sector was explicitly mentioned in most of the interventions. Unlike the immediate responses adopted above, these economic measures were on a medium to long-term basis. Despite the increasing concerns about how the pandemic will likely impact the clean energy transition, we did not find any specific mention of this issue in the economic measures outlined by countries so far. Commentaries on this issue, however, suggests that COVID-19 presents both challenges and opportunities for the clean energy transition.

Following the peak of renewable energy investments in 2017, such investments have since been on a decline [72]. COVID-19 could worsen this situation given that it has impacted negatively on liquidity conditions across the globe. Declining liquidity adversely affects both ongoing RE projects as well as planned investments and can potentially lead to a halt in the growth rate of RE installations. On the other hand, Shah [2] asserts that investors are increasingly moving away from riskier opportunities; hence, the slump in global oil markets could see more liquidity driven towards the RE sector. Consistent with this assertion, Nigeria, Africa's biggest oil producer, has moved to scrap subsidies paid to the gasoline sector in the country due to the global fall in oil prices which was caused by the pandemic [69]. However, it is unclear if this measure will directly benefit the renewables industry. The expected savings are expected to be invested in infrastructure,

healthcare, and education [69] without a specific mention of renewables. Another challenge posed by the pandemic is the disruption of the global RE supply chains. China has been the leading supplier of various RE components, but it has also been hard hit by the virus and several companies have been closed down. Perhaps, the effects of this disruption have already manifested in the United States, where a shortage of solar components has led to a price hike of about 15% in the US markets [2]. Various economic stimulus packages introduced by governments across the globe is another avenue of opportunity for the clean energy transition. Shah [2] recounts that globally, there have been more than 7 trillion US dollars pledged towards stimulating post-COVID-19 economic recovery.

Indeed, it is acknowledged that RE growth in post-COVID-19 will largely depend on government policies and economic stimulus packages that could engender clean transitions [1]. Our review has shown that Africa countries have been developing such stimulus packages in response to the pandemic, but what remains unclear is how these government policies and economic measures will drive the clean energy transition as they do not explicitly mention it. Also, whilst it is expected that government policies and investments will play a vital role in the post-COVID-19 clean energy transition, such investments may be more pronounced in the developed countries than the developing ones in Africa due to the limited financial resources of several countries in the continent [1]. Overall, the evolving nature of the COVID-19 situation makes it difficult to predict what the pandemic really means for the energy sector and the clean energy transition. Our review provides an important baseline to understand government responses to this issue. In line with past studies (see, for example [73,74]), we argue that disruptions such as COVID-19 are not necessarily destructive as they also present some opportunities that can be leveraged to drive the clean energy transition. Indeed, most government economic stimulus packages reviewed in this study do not explicitly outline strategies for the clean energy transition. However, the emergence of independent funding opportunities purposely for clean energy companies in response to the COVID-19 suggests that the renewables sector in Africa may see a significant boost in the post-COVID-19 world. Some of these funding sources include the COVID-19 Energy Access Relief Fund [75], the GET-Invest COVID-19 Window for energy projects in sub-Saharan Africa and the Caribbean [76], the REACT Kenya Relief Fund for off-grid companies [71], and the All On COVID-19 Solar Relief Fund in Nigeria [68] amongst others. It is, however, imperative for governments to prioritize clean energy investments in their COVID-19 recovery efforts. We also propose the following for further research.

Future research needs to critically examine whether or not, government economic stimulus packages and other policies adopted comprehensively take into account the clean energy transition in post-COVID-19. There is the need to ascertain investment plans for REs, government support for decentralized electricity producers as well as other actors in the RE sector. Despite the disruptions caused by the pandemic and the many potential adverse effects it may have on the clean energy transition, there is some sanguinity for future RE development. Thus, research must not only focus on the negatives but also on identifying the opportunities that COVID-19 presents for RE growth in Africa. Another important thing that future research can examine is whether or not the COVID-19 pandemic will spur economic diversification in oil-rich countries, given the global downturn in oil prices. Also, how the pandemic has affected user behavior and practices with regards to energy is an area that needs inquiry. For example, how did the provision of incentives such as waivers of utility bills and the provision of free electricity affect energy efficiency and conservation behavior and practices among end-users? Findings from such research can be a good indicator of individuals' consciousness and willingness to adopt sustainable energy lifestyles even if their usage of energy does not cost them money. It can also provide an avenue for testing behavioral theories such as the theory of planned behavior and the social cognitive theory.

Finally, given the huge dependence of African countries on aid from the developed countries, it is imperative to ascertain how changes in the priorities of advanced countries and international organizations due to the COVID-19 will affect funding for RE projects in Africa. How such changes might affect technological transfers from developed countries to developing ones in Africa is also important. Our findings must be considered with cognizance of the limitation that the COVID-19 situation is still evolving, and there may have been some new developments or changes since this paper was written. Epidemiological data presented in section 2, for instance, keeps changing on a daily basis. Also, while comprehensive information on energy-sector responses to COVID-19 exists for some countries, others have very scanty or no information at all. Where present, some countries do not have detailed information for all aspects (types of interventions, their nature, and economic stimulus packages). This situation has made it impossible to provide detailed discussions for every relevant aspect for each country. Individual country-level studies may address this limitation in the future.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgement

The authors are thankful to the journal editor and the anonymous reviewers for their insightful comments and suggestions which greatly improved the manuscript.

## References

- [1] G. Goodrich, The Impact of COVID-19 on Africa's Energy Transition, Africa Oil Power, 2020. <https://www.africaoilandpower.com/2020/05/11/the-impact-of-covid-19-on-africas-energy-transition/> (accessed June 1, 2020).
- [2] S. Shah, Covid-19 and the clean energy challenges and opportunities, Standard Chartered, 2020. <https://www.sc.com/en/trade-beyond-borders/covid-19-clean-energy-challenges-and-opportunities/> (accessed June 1, 2020).
- [3] IEA, COVID-19: Exploring the impacts of the Covid-19 pandemic on global energy markets, energy resilience, and climate change, 2020. <https://www.iea.org/topics/covid-19> (accessed May 9, 2020).
- [4] T. Mylenka, Impact of Covid-19 on the global energy sector, Pv Mag. Int., 2020. <https://www.pv-magazine.com/2020/04/24/impact-of-covid-19-on-the-global-energy-sector/> (accessed May 9, 2020).
- [5] GOGLA, COVID-19 Energy Access Relief Fund, 2020. <https://www.energyaccessrelief.org/> (accessed May 9, 2020).
- [6] IRENA, Off-grid renewable energy in Africa, Abu Dhabi, 2016. [https://www.lightingglobal.org/wp-content/uploads/2016/03/20160301\\_OffGridSolarTrendsReport.pdf](https://www.lightingglobal.org/wp-content/uploads/2016/03/20160301_OffGridSolarTrendsReport.pdf) (accessed May 9, 2020).
- [7] IRENA, Renewable Energy and Jobs – Annual Review 2019, Abu Dhabi, 2019. [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jun/IRENA\\_RE\\_Jobs\\_2019-report.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jun/IRENA_RE_Jobs_2019-report.pdf) (accessed May 9, 2020).
- [8] GOGLA, Employment opportunities in an evolving market. Off-grid solar: creating high-value employment in key markets, Utrecht, 2018. [https://www.gogla.org/sites/default/files/resource\\_docs/job\\_creation\\_in\\_the\\_og\\_sector\\_-\\_policy\\_note\\_1.pdf](https://www.gogla.org/sites/default/files/resource_docs/job_creation_in_the_og_sector_-_policy_note_1.pdf) (accessed May 9, 2020).
- [9] S.S. Qarnain, S. Muthuvel, S. Bathrinath, Review on government action plans to reduce energy consumption in buildings amid COVID-19 pandemic outbreak, Mater. Today Proc., 2020, in press. <https://doi.org/10.1016/j.matpr.2020.04.723>.
- [10] J.J. Klemesš, Y. Van Fan, R.R. Tan, P. Jiang, Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19, Renew. Sustain. Energy Rev. 127 (2020) 109883, <https://doi.org/10.1016/j.rser.2020.109883>.
- [11] B. Steffen, F. Egli, M. Pahle, T.S. Schmidt, Navigating the clean energy transition in the COVID-19 Crisis, Joule 4 (2020) 1137–1141, <https://doi.org/10.1016/j.joule.2020.04.011>.
- [12] Q. Wang, M. Su, A preliminary assessment of the impact of COVID-19 on environment – a case study of China, Sci. Total Environ. 728 (2020) 138915, <https://doi.org/10.1016/j.scitotenv.2020.138915>.

- [13] P. Lal, A. Kumar, S. Kumar, S. Kumari, P. Saikia, A. Dayanandan, D. Adhikari, M.L. Khan, The dark cloud with a silver lining: Assessing the impact of the SARS COVID-19 pandemic on the global environment, *Sci. Total Environ.* 732 (2020), <https://doi.org/10.1016/j.scitotenv.2020.139297>.
- [14] M.A. Zambrano-Monserrate, M.A. Ruano, L. Sanchez-Alcalde, Indirect effects of COVID-19 on the environment, *Sci. Total Environ.* 728 (2020) 138813, <https://doi.org/10.1016/j.scitotenv.2020.138813>.
- [15] S. Saadat, D. Rawtani, C.M. Hussain, Environmental perspective of COVID-19, *Sci. Total Environ.* 728 (2020) 138870, <https://doi.org/10.1016/j.scitotenv.2020.138870>.
- [16] S. Muhammad, X. Long, M. Salman, COVID-19 pandemic and environmental pollution: a blessing in disguise? *Sci. Total Environ.* 728 (2020) 138820, <https://doi.org/10.1016/j.scitotenv.2020.138820>.
- [17] Y. Wu, W. Jing, J. Liu, Q. Ma, J. Yuan, Y. Wang, M. Du, M. Liu, Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries, *Sci. Total Environ.* 729 (2020) 139051, <https://doi.org/10.1016/j.scitotenv.2020.139051>.
- [18] M. Bannister-Tyrrell, A. Meyer, C. Faverjon, A. Cameron, Preliminary evidence that higher temperatures are associated with lower incidence of COVID-19, for cases reported globally up to 29th February 2020, *MedRxiv*, 2020, 2020.03.18.20036731. <https://doi.org/10.1101/2020.03.18.20036731>.
- [19] F. Shahzad, U. Shahzad, Z. Fareed, N. Iqbal, S.H. Hashmi, F. Ahmad, Asymmetric nexus between temperature and COVID-19 in the top ten affected provinces of China: a current application of quantile-on-quantile approach, *Sci. Total Environ.* 736 (2020) 139115, <https://doi.org/10.1016/j.scitotenv.2020.139115>.
- [20] R. Tosepu, J. Gunawan, D.S. Effendy, L.O.A.I. Ahmad, H. Lestari, H. Bahar, P. Asfian, Correlation between weather and Covid-19 pandemic in Jakarta, Indonesia, *Sci. Total Environ.* 725 (2020) 138436, <https://doi.org/10.1016/j.scitotenv.2020.138436>.
- [21] M.F. Bashir, B. Ma, Bilal, B. Komal, M.A. Bashir, D. Tan, M. Bashir, Correlation between climate indicators and COVID-19 pandemic in New York, USA, *Sci. Total Environ.* 728 (2020) 138835, <https://doi.org/10.1016/j.scitotenv.2020.138835>.
- [22] B. Paital, Nurture to nature via COVID-19, a self-regenerating environmental strategy of environment in global context, *Sci. Total Environ.* 729 (2020) 139088, <https://doi.org/10.1016/j.scitotenv.2020.139088>.
- [23] WHO, COVID-19 Situation update for the WHO African Region. 4 March 2020: External situation Report 1, Brazaville, 2020. [https://apps.who.int/iris/bitstream/handle/10665/331330/SITREP\\_COVID-19\\_WHOAFRO\\_20200304-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/331330/SITREP_COVID-19_WHOAFRO_20200304-eng.pdf) (accessed May 15, 2020).
- [24] WHO, COVID-19 Situation update for the WHO African Region. 4 March 2020: External situation Report 11, Brazaville, 2020. [https://apps.who.int/iris/bitstream/handle/10665/332078/SITREP\\_COVID-19\\_WHOAFRO\\_20200513-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/332078/SITREP_COVID-19_WHOAFRO_20200513-eng.pdf) (accessed May 15, 2020).
- [25] WHO, African countries start easing COVID-19 confinement measures, 2020. <https://www.afro.who.int/news/african-countries-start-easing-covid-19-confinement-measures> (accessed May 16, 2020).
- [26] A. de Waal, Coronavirus: why lockdowns may not be the answer in Africa – BBC News, 2020. <https://www.bbc.com/news/world-africa-52268320> (accessed May 16, 2020).
- [27] U. Gentilini, M. Almenfi, I. Orton, P. Dale, Social Protection and jobs responses to COVID-19: a real-time review of country measures, World Bank, Washington DC, 2020. <http://documents.worldbank.org/curated/en/958361587405455498/pdf/Social-Protection-and-Jobs-Responses-to-COVID-19-A-Real-Time-Review-of-Country-Measures-April-17-2020.pdf> (accessed May 11, 2020).
- [28] L.M. Stevens, The impact of COVID-19 on the Energy, Mining and Infrastructure sectors in Africa, 2020. <https://africa-energy-portal.org/blogs/impact-covid-19-energy-mining-and-infrastructure-sectors-africa> (accessed June 18, 2020).
- [29] IEA, Africa and Covid-19: Economic recovery and electricity access go hand in hand, 2020. <https://www.iea.org/commentaries/africa-and-covid-19-economic-recovery-and-electricity-access-go-hand-in-hand> (accessed June 18, 2020).
- [30] Havenhill Synergy, The impact of COVID-19 on the off-grid energy sector, Sun-Connect-News, 2020. <https://www.sun-connect-news.org/articles/market/details/the-impact-of-covid-19-on-the-off-grid-energy-sector/> (accessed June 18, 2020).
- [31] GOGLA, Consumer Insights during COVID-19, Consum. Insights Dashboard/60 Decibels, 2020. <https://app.60decibels.com/covid-19#explore> (accessed June 18, 2020).
- [32] E. Glusac, How Will Coronavirus Affect Future Travel Behavior? A Travel Crisis Expert Explains, *The New York Times*, 2020. <https://www.nytimes.com/2020/04/15/travel/q-and-a-coronavirus-travel.html> (accessed June 19, 2020).
- [33] IATA, Aviation Relief for African Airlines Critical as COVID-19 Impacts Deepen, Pressroom, 2020. <https://www.iata.org/en/pressroom/pr/2020-04-23-02/> (accessed June 19, 2020).
- [34] M. Bazilian, S. Nakhoda, T. Van De Graaf, Energy governance and poverty, *Energy Res. Soc. Sci.* 1 (2014) 217–225, <https://doi.org/10.1016/j.erss.2014.03.006>.
- [35] M.J. Burke, J.C. Stephens, Political power and renewable energy futures: a critical review, *Energy Res. Soc. Sci.* 35 (2018) 78–93, <https://doi.org/10.1016/j.erss.2017.10.018>.
- [36] J.D.Y. Kim, E. Choi, E. Lee, Social justice, fairness and exclusion in the South Korean electricity sector, *Energy Res. Soc. Sci.* 51 (2019) 55–66, <https://doi.org/10.1016/j.erss.2018.12.002>.
- [37] R. Gillard, C. Snell, M. Bevan, Advancing an energy justice perspective of fuel poverty: household vulnerability and domestic retrofit policy in the United Kingdom, *Energy Res. Soc. Sci.* 29 (2017) 53–61, <https://doi.org/10.1016/j.erss.2017.05.012>.
- [38] IMF, Policy Responses to COVID19, 2020. <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#C> (accessed May 10, 2020).
- [39] J. Peskett, IATA 'not satisfied' by MENA governments' response to aviation disaster – COVID-19, Iata – Aviation Business Middle East, 2020. <https://www.aviationbusinessme.com/covid-19/21476-iata-not-satisfied-by-mena-governments-response-to-aviation-disaster> (accessed June 22, 2020).
- [40] F. Bate, Total told it cannot acquire Anadarko Algeria assets, *Reuters Commod.* (2020).
- [41] The Africa Report, Coronavirus in Algeria: A country's last warning, *Africa Rep. Corona Chronicles*, 2020. <https://www.theafricareport.com/25365/coronavirus-in-algeria-a-countrys-last-warning/> (accessed May 11, 2020).
- [42] T. Herman, E. Maarek, N. Wilde, F. Adao, S. Abousaada, COVID-19: Initial responses of certain African countries, *Herbert Smith Free. Leg. Brief*, 2020. <https://www.herbertsmithfreehills.com/latest-thinking/covid-19-initial-responses-of-certain-african-countries-africa> (accessed May 6, 2020).
- [43] T. Emtairah, COVID-19 stimulus packages must carry energy efficiency incentives to help industries and economies rebound, *UNIDO's Ind. Energy Accel*, 2020. <https://www.unido.org/stories/covid-19-stimulus-packages-must-carry-energy-efficiency-incentives-help-industries-and-economies-rebound> (accessed May 11, 2020).
- [44] K. Nasrollah, K. Boudribila, COVID-19: specific measures implemented in Morocco, *Insight | Bak. McKenzie*, 2020. <https://www.bakermckenzie.com/en/insight/publications/2020/03/covid19-specific-measures-morocco> (accessed June 22, 2020).
- [45] 2M News, RAM: losses of 50 MDH per day, recovery over a minimum period of 36 months, 2020. <http://2m.ma/fr/news/ram-des-perdes-de-50-mdh-par-jour-la-reprise-sur-une-periode-minimale-de-36-mois-20200513/> (accessed June 22, 2020).
- [46] OECD, The COVID-19 Crisis in Morocco, Paris, 2020.
- [47] OECD, The Covid-19 Crisis in Egypt, Paris, 2020. <https://www.oecd.org/mena/competitiveness/The-Covid-19-Crisis-in-Egypt.pdf>.
- [48] Enterprise, How covid-19 and oil price volatility are impacting Egypt's renewable energy sector, 2020. <https://enterprise.press/stories/2020/05/20/how-covid-19-and-oil-price-volatility-are-impacting-egypts-renewable-energy-sector-part-2-the-oil-shock-16222/> (accessed June 22, 2020).
- [49] UNICEF, MAURITANIA Coronavirus (COVID-19) Situation Report No. 3, Nouakchott, 2020. [https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF\\_Mauritania\\_COVID-19\\_Situation\\_Report\\_No.\\_3\\_-\\_4-9\\_April\\_2020.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF_Mauritania_COVID-19_Situation_Report_No._3_-_4-9_April_2020.pdf) (accessed May 11, 2020).
- [50] UNOCHA, Libya: Hostilities threaten COVID-19 response, *United Nations Off. Coord. Humanit. Aff.*, 2020. <https://www.unocha.org/story/libya-hostilities-threaten-covid-19-response> (accessed May 10, 2020).
- [51] H. Boffu, South Sudan Oil & Gas Licensing Round Affected by Covid-19, 2020. <http://tanzaniapetroleum.com/2020/05/13/south-sudan-oil-gas-licensing-round-affected-by-covid-19/> (accessed June 22, 2020).
- [52] Xuxin, South Sudan delays oil licensing round set for March due to COVID-19 – Xinhua | English.news.cn, 2020. <http://www.xinhuanet.com/english/2020-03/18/c.138892485.htm> (accessed June 22, 2020).
- [53] SARDC, SADC energy sector braces for COVID-19 impact, 2020. <https://www.sardc.net/en/southern-african-news-features/sadc-energy-sector-braces-for-covid-19-impact/> (accessed June 22, 2020).
- [54] CLBrief, Analysis: Angolan economy set for Covid-19 blow, *China-Lusophone Br*, 2020. <https://www.clbrief.com/analysis-angolan-economy-set-for-covid-19-blow/> (accessed June 22, 2020).
- [55] Reuters, Angola's oil exploration evaporates as COVID-19 overshadows historic reforms, *Oil Gas 360*, 2020. <https://www.oilandgas360.com/angolas-oil-exploration-evaporates-as-covid-19-overshadows-historic-reforms/> (accessed June 22, 2020).
- [56] UNCTAD, COVID-19 affirms urgency of trade facilitation reforms in Angola, 2020. <https://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=2329> (accessed May 11, 2020).
- [57] Government of Botswana, Guidelines for the COVID 19 Wage Subsidy, 2020. [http://www.burs.org.bw/images/img/BURS\\_COVID\\_19\\_WAGE\\_SUBSIDY\\_GUIDELINES-FINAL\\_2020.pdf](http://www.burs.org.bw/images/img/BURS_COVID_19_WAGE_SUBSIDY_GUIDELINES-FINAL_2020.pdf) (accessed May 10, 2020).
- [58] KPMG, Botswana – Measures in response to COVID-19, *Gov. Inst. Meas. Response to COVID-19*, 2020. <https://home.kpmg/xx/en/home/insights/2020/04/botswana-government-and-institution-measures-in-response-to-covid.html> (accessed May 10, 2020).
- [59] B. Benza, Botswana hikes power tariffs by 22% to help loss-making utility – Reuters, *Reuters Energy News*, 2020. <https://www.reuters.com/article/botswana-power/botswana-hikes-power-tariffs-by-22-to-help-loss-making-utility-idUSL8N2B15Z9> (accessed May 10, 2020).
- [60] B. Felix, M. Mucari, Total working with Mozambique to manage COVID-19 cases at LNG site, *Reuters Commod.*, 2020. <https://www.reuters.com/article/us-health-coronavirus-total-mozambique/total-working-with-mozambique-to-manage-covid-19-cases-at-lng-site-idUSKBN21Z2CJ> (accessed June 22, 2020).
- [61] KPMG, Mozambique – Measures in response to COVID-19, *Gov. Inst. Meas. Response to COVID-19*, 2020. <https://home.kpmg/xx/en/home/insights/2020/04/mozambique-government-and-institution-measures-in-response-to-covid.html> (accessed May 10, 2020).
- [62] Government of Eswatini, King Urges Nation To Heed To Health Precautions As Partial Lockdown Is Eased., *Prime Minist. Statement Natl. Response to Covid-19 Updat.*, 2020. <http://www.gov.sz/index.php/latest-news/204-latest-news> (accessed May 11, 2020).
- [63] H. Winkler, Power shortages will remain a big challenge in a post-COVID-19 South Africa, *Convers. Environ. Energy*, 2020. <https://theconversation.com/power-shortages-will-remain-a-big-challenge-in-a-post-covid-19-south-africa-134589> (accessed May 9, 2020).
- [64] T.E. Ndoro, ZESA increases electricity tariffs, here are the new tariffs, *IHarare News*, 2020. <https://ihare.com/zesa-increases-electricity-tariffs-here-are-the-new->

- tariffs/ (accessed May 10, 2020).
- [65] Presidency of Burkina Faso, MESSAGE TO THE NATION OF HIS EXCELLENCY MONSIEUR ROCH MARC CHRISTIAN KABORE, PRESIDENT OF FASO, PRESIDENT OF THE COUNCIL OF MINISTERS ON THE PANDEMIC OF COVID-19. Presidency of Faso, State of the Nations Address, 2020. <https://www.presidenceufaso.bf/mes-sage-a-la-nation-de-son-excellence-monsieur-roch-marc-christian-kabore-president-du-faso-president-du-conseil-des-ministres-sur-la-pandemie-du-covid-19/> (accessed May 10, 2020).
- [66] KPMG, Ivory Coast-Government and institution measures in response to COVID-19, Government Inst. Meas. Response to COVID-19, 2020, pp. 2–18. <https://home.kpmg/xx/en/home/insights/2020/04/ivory-coast-government-and-institution-measures-in-response-to-covid.html> (accessed May 10, 2020).
- [67] The Presidency of the Republic of Ghana, President Akufo-Addo On Updates To Ghana's Enhanced Response To COVID-19, 2020. <http://presidency.gov.gh/index.php/briefing-room/speeches/1560-president-akufo-addo-speaks-on-updates-to-ghana-s-enhanced-response-to-covid-19> (accessed May 10, 2020).
- [68] ESI Africa, COVID-19 emergency support package to electrify health centres in Africa, 2020. <https://www.esi-africa.com/industry-sectors/renewable-energy/covid-19-emergency-support-package-to-electrify-health-centres-in-africa/> (accessed May 11, 2020).
- [69] E. Bala-Gbogbo, Nigeria Ending Fuel Subsidies With Oil at Record-Low Prices – Bloomberg, Markets, 2020. <https://www.bloomberg.com/news/articles/2020-04-09/nigeria-ending-fuel-subsidies-with-oil-at-record-low-prices> (accessed June 18, 2020).
- [70] UNDP, Mapping of Fiscal and Social Protection Policy Responses to COVID-19 – Mauritius and Seychelles, Addis Ababa, 2020. [https://www.undp.org/content/dam/rba/docs/COVID-19-CO-Response/Government\\_COVID\\_Responses\\_Mauritius\\_Seychelles\\_29March2020RB-2.pdf](https://www.undp.org/content/dam/rba/docs/COVID-19-CO-Response/Government_COVID_Responses_Mauritius_Seychelles_29March2020RB-2.pdf).
- [71] AECF, REACT Kenya Relief Fund | AECF, (2020). <https://www.aecfafrica.org/index.php/covid-19> (accessed June 18, 2020).
- [72] Y. Zhai, Y. Lee, Investment in renewable energy is slowing down. Here's why, World Econ. Forum Asian Dev. Bank, 2019. <https://www.weforum.org/agenda/2019/09/global-renewable-energy-investment-slowing-down-worry/> (accessed June 1, 2020).
- [73] J. Markard, D. Rosenbloom, A tale of two crises: COVID-19 and climate, *Sustain. Sci. Pract. Policy* ISSN. 16 (2020) 53–60, <https://doi.org/10.1080/15487733.2020.1765679>.
- [74] J. Markard, N. Bento, N. Kittner, A. Nuñez-Jimenez, Destined for decline? Examining nuclear energy from a technological innovation systems perspective, *Energy Res. Soc. Sci.* 67 (2020) 101512, <https://doi.org/10.1016/j.erss.2020.101512>.
- [75] Energy Access Relief, Covid-19 Energy Access Relief Response, (2020). <https://www.energyaccessrelief.org/> (accessed June 19, 2020).
- [76] GET.invest, Covid-19 Window , (2020). <https://www.get-invest.eu/finance-catalyst/covid-19-window/> (accessed June 19, 2020).